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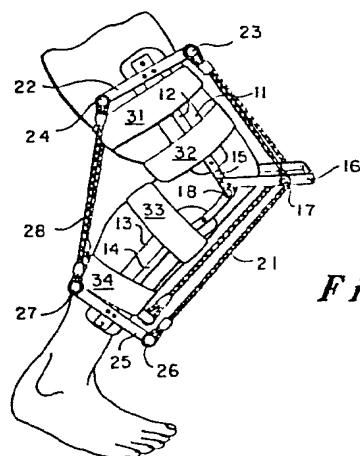
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54 **Limb exerciser.**

57 A limb exerciser, such as for a leg, comprises a brace hinged at the middle (18) with upper padded members (11) for snugly engaging the upper portion of the limb and lower padded members (13) for snugly engaging the lower portion of the limb. Elastic hook-and-loop fasteners (31, 32, 33, 34) surround the members (11, 13) and the limb to firmly secure the members to the limb. A U-shaped portion (16) extends beyond the centre of the hinge (18) and carries fulcrum assemblies (17) on each leg of the U over which elastic cords (21) ride. The ends of the cords (21) are attached to upper studs (23, 26) at the far ends of the upper and lower members (11, 13). A second pair of elastic cords (28) are connected between lower studs (24, 27) at the far end of the respective members (11, 13).



*Fig. 2*

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LIMB EXERCISER

5. The present invention relates in general to limb muscle exercising and more particularly concerns apparatus for exercising leg and arm muscles that is relatively easy to install on a wide variety of leg and arm sizes while facilitating variation of the nature of the exercise.

10. After knee surgery, it is common to treat patients with physical therapy to strengthen leg muscles inactive during recovery. It is also desirable to strengthen these muscles in a healthy person to enhance performance in athletic events, help prevent injury and for general well being. A number of exercising aids have been available for this purpose, such as weights attached to the ankle and weight- or spring-loaded lines  
15. with a ring at the end for engaging the foot. These prior art approaches have a number of disadvantages, such as inconvenient locations for using, limitations on muscles exercised and inconvenience in use.

20. It is an important object of this invention to provide improved apparatus and techniques for limb exercising.

- According to the invention, limb exercising apparatus comprises upper and lower means for snugly engaging the upper and lower portions respectively of a limb, on opposite sides of a joint, means for hingeably attaching the upper means to the lower means, and resilient means connected between the upper means and the lower means for exerting a torque about the axis of the hinge means, against which limb muscles may work when the upper and lower portions of a limb are
5. respectively secured to the upper and lower means, and the limb is extended and contracted about the joint. Such apparatus is relatively easy to use by unskilled personnel and allows the user to perform other activities while exercising. Preferably, the resilient
10. means includes an elastic member extending over fulcrum means above the hinge axis.
- 15.

An example of apparatus according to the invention will now be described, with reference to the accompanying drawings, in which:-

20. Figure 1 is a perspective view of the apparatus with a leg extended;
- Figure 2 is a perspective view corresponding to Figure 1, but with the leg contracted; and
- Figures 3 and 4 are side and top views of the
25. apparatus of Figures 1 and 2 without the leg.

- The apparatus is in the form of a brace which includes padded upper leg support portions 11 secured to upper rods 12. Similarly padded lower leg support members 13 are secured to lower rods 14. Lower rods 14
30. are hingeably connected at the top to hinge members 15

- that are fastened to the lower end of upper rods 12 whereby the upper and lower portions are hingeably attached so that when fastened to the leg, the hinge axis corresponds substantially to the hinge axis of the knee.
5. A U-shaped member 16 extends outward from hinge member 15 forming an obtuse angle with upper rod 12. The legs of member 16 carry bolt-washer-sleeve assemblies 17 located above the hinge axis 18 to define
10. a fulcrum for upper elastic members 21. Member 16 may be adjusted to widen or tighten the brace for better fit around the limb, e.g. it may telescope to accommodate legs of different widths.
15. Transverse rods 22 are secured to the upper end of rods 12 and carry at the ends upper studs 23 and lower studs 24. Similarly transverse rods 25 are fastened to the lower rods 14 and carry upper studs 26 and lower studs 27. Upper spring bands 21 have loops at each end surrounding studs 23 and 26 and extend over
20. assemblies 17. Lower elastic members 28 are similarly looped at each end with the loops surrounding lower studs 24 and 27, respectively. Upper elastic hook-and-loop fasteners 31 and 32 and lower elastic hook-and-loop fasteners 33 and 34 are attached to the upper and lower
25. portions and wrapped around the respective portions with upper and lower leg portions between upper members 11 and lower members 13 respectively, to clamp these leg portions between the respective members with the hinge axis 18 corresponding substantially to the joint axis.
30. Fasteners 31 and 32 may be plain non-elastic straps.

Having described the structural arrangement of the apparatus, its mode of operation will be described. First, with elastic members 21 and 28 removed and hook-and-loop elastic fasteners 31, 32, 33 and 34 unwrapped, 5. the apparatus is placed on a leg with the upper leg portion sandwiched between members 11 and the lower leg portion sandwiched between members 13 with hinge axis 18 corresponding substantially to the knee hinge axis.

Fasteners 31, 32, 33 and 34 are then wrapped 10. around members 11 and 13 and the leg portions therebetween to firmly secure the assembly to the leg. For a first exercise, elastic members 21 are fastened between upper studs 23 and 26 and over fulcrum assemblies 17 with the leg extended. The leg is then contracted and 15. cycled between being extended and contracted to exercise appropriate muscles for a number of times. The exerciser may exercise while sitting and reading or watching television. The amount of exercise may be varied by varying the force exerted by the elastic 20. members 21. For example, to provide more force, members 21 may be shorter when fully contracted, thicker or stronger.

After exercising with elastic members 21, these members may be removed, and elastic members 28 25. attached between lower studs 24 and 27 attached with the leg contracted. Extending the leg then exercises those muscles used in extension working against the restoring force of elastic members 28.

In a particular example, the separation 30. between upper studs 23 and 26 with the assembly in the

position of the leg fully extended was substantially 19 inches (482 mm) while that between lower studs 24 and 27 was substantially 17 inches (431 mm). A suitable length for upper elastic members 21 was substantially 18 inches (457 mm) made of elastic cord, substantially  $\frac{3}{8}$  inches (9 mm) in diameter. Suitable length for elastic member 28 was substantially 11 inches (279 mm) of elastic cord, substantially  $\frac{1}{4}$  inches (6 mm) in diameter.

As examples of variations, hinges 18 may allow full joint motion or may be arranged for limiting part of the joint motion. Sometimes after surgery it is desirable to avoid full motion while exercising over part of the joint movement range. This limitation may be accomplished by placing a stud in one hinge. There are available braces with limited motion hinges.

As still another alternative, rods 12 and 14 may be telescoping to make the structure more compact and portable. This telescoping feature may also be useful in connection with accommodating limbs of different lengths.

Member 16 may take a number of different shapes, such as being circular, elliptical and other shapes and may accommodate limbs of different widths. It may be adjusted by gliding, over-lapping, screw or other adjusting techniques. It may be a telescoping member.

Fulcrum 17 may be attached to member 16 or independently to rod 12 or as an extension of hinge member 15. The structural arrangement embodies the concept of effectively using limb muscles to extend a

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spring member, such as an elastic or spring over a fulcrum.

5. The apparatus may be used for strengthening an arm, working around the elbow joint and the leg working around the knee joint. The apparatus allows a limb to which it is attached to be exercised separately without requiring manual assistance.

10. Apparatus according to the invention may be embodied in still other different forms. For example, the elastic members could be coil springs or attached in a number of different locations and in a number of different forms, for example, spiral springs around hinge axis 18. For example, elastic members could be connected between upper studs 23 and lower studs 27 or  
15. between lower studs 24 and upper studs 26, crossing over or under the joint from inside out or vice versa. Numerous techniques may be used for fastening the upper and lower portions to upper and lower leg portions respectively. It is evident that those skilled in the  
20. art may now make numerous other uses and modifications of and departures from the specific embodiments described herein without departing from the inventive concepts.

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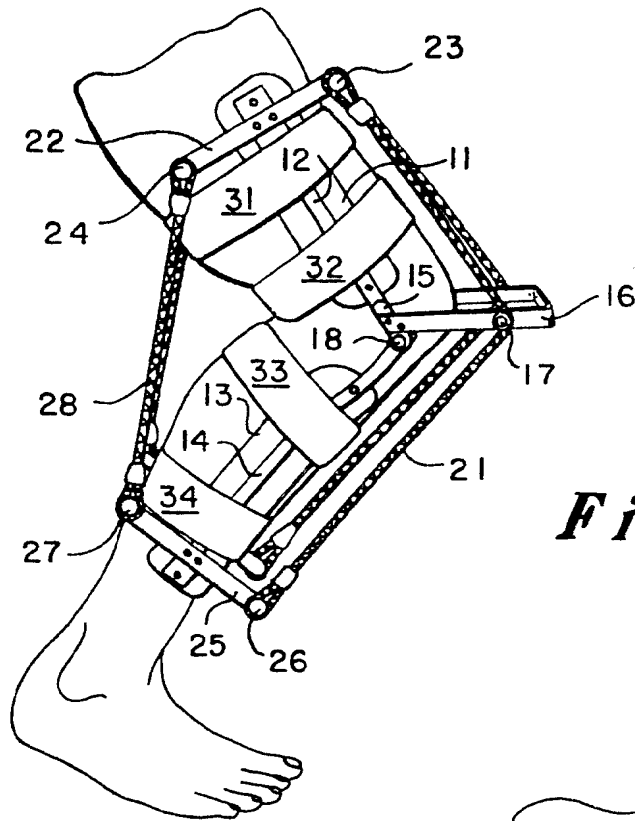


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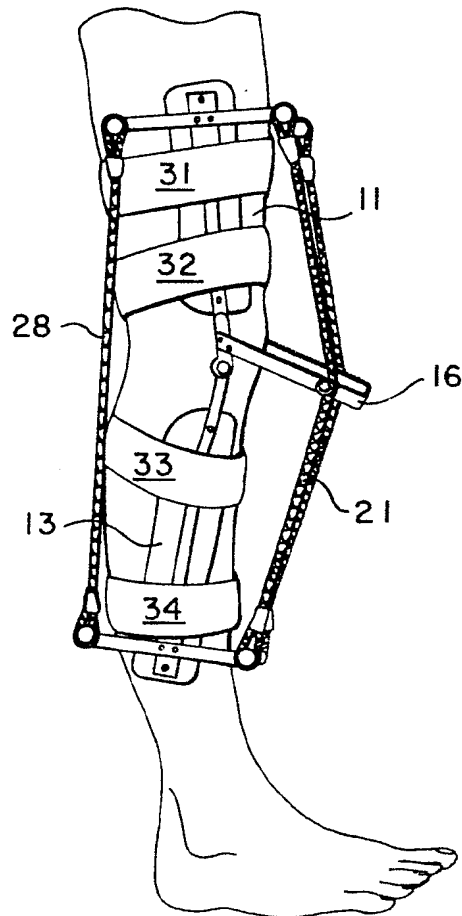
1.           Limb exercising apparatus comprising upper and lower means for snugly engaging the upper and lower portions respectively of a limb, on opposite sides of a joint, means for hingeably attaching the upper means to the lower means, and resilient means connected between the upper means and the lower means for exerting a torque about the axis of the hinge means, against which limb muscles may work when the upper and lower portions of a limb are respectively secured to the upper and lower means, and the limb is extended and contracted about the joint.
2.           Limb exercising apparatus in accordance with claim 1 in which the resilient means includes an elastic member extending over fulcrum means above the hinge axis.
3.           Limb exercising apparatus in accordance with claim 2 wherein the upper and lower means have studs to which the ends of the elastic member are attached.
4.           Limb exercising apparatus in accordance with claim 3 wherein there are upper and lower studs, the lower studs being for receiving a resilient member forming part of the resilient means so that extending the limb stretches the latter resilient member.

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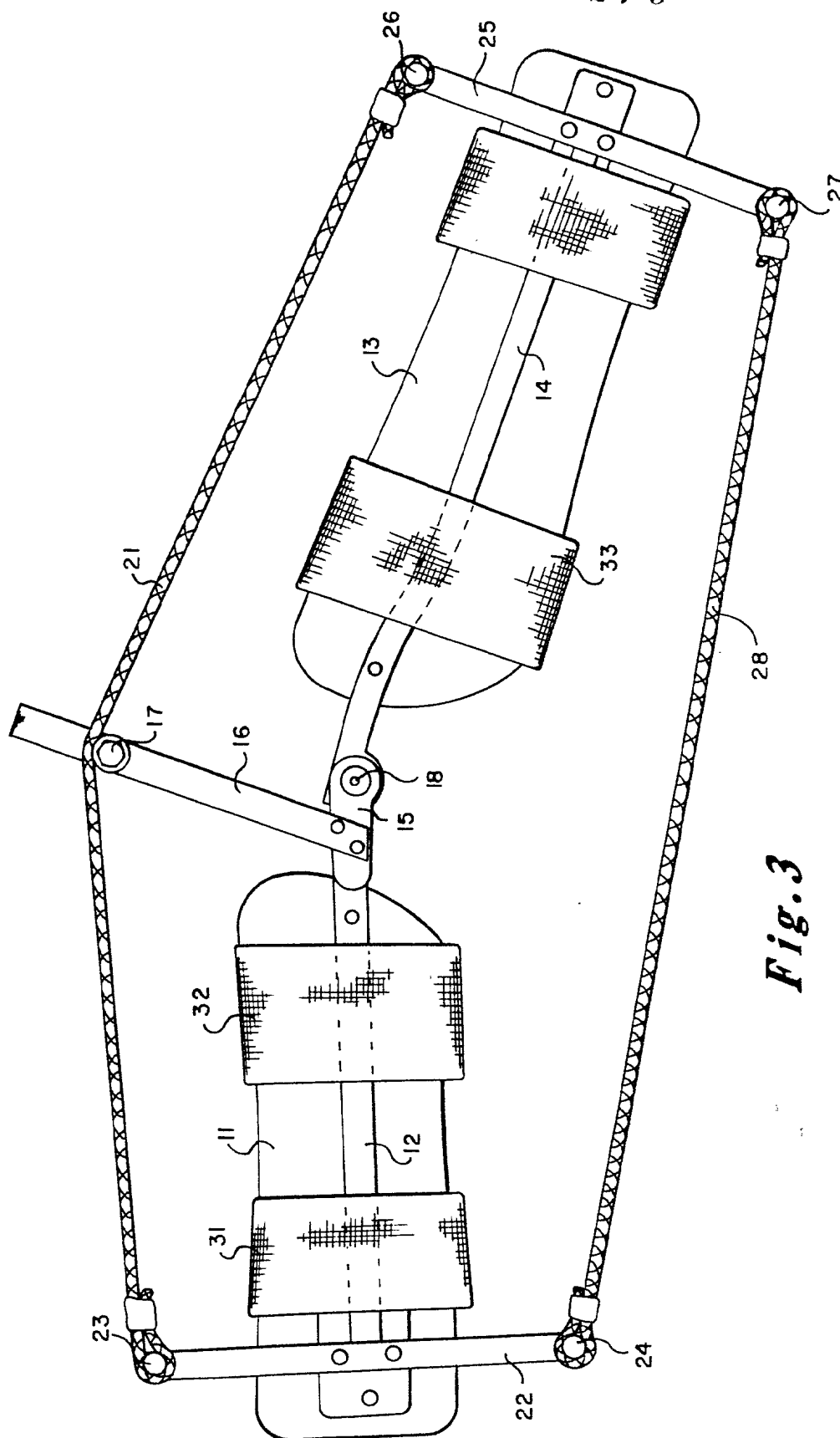
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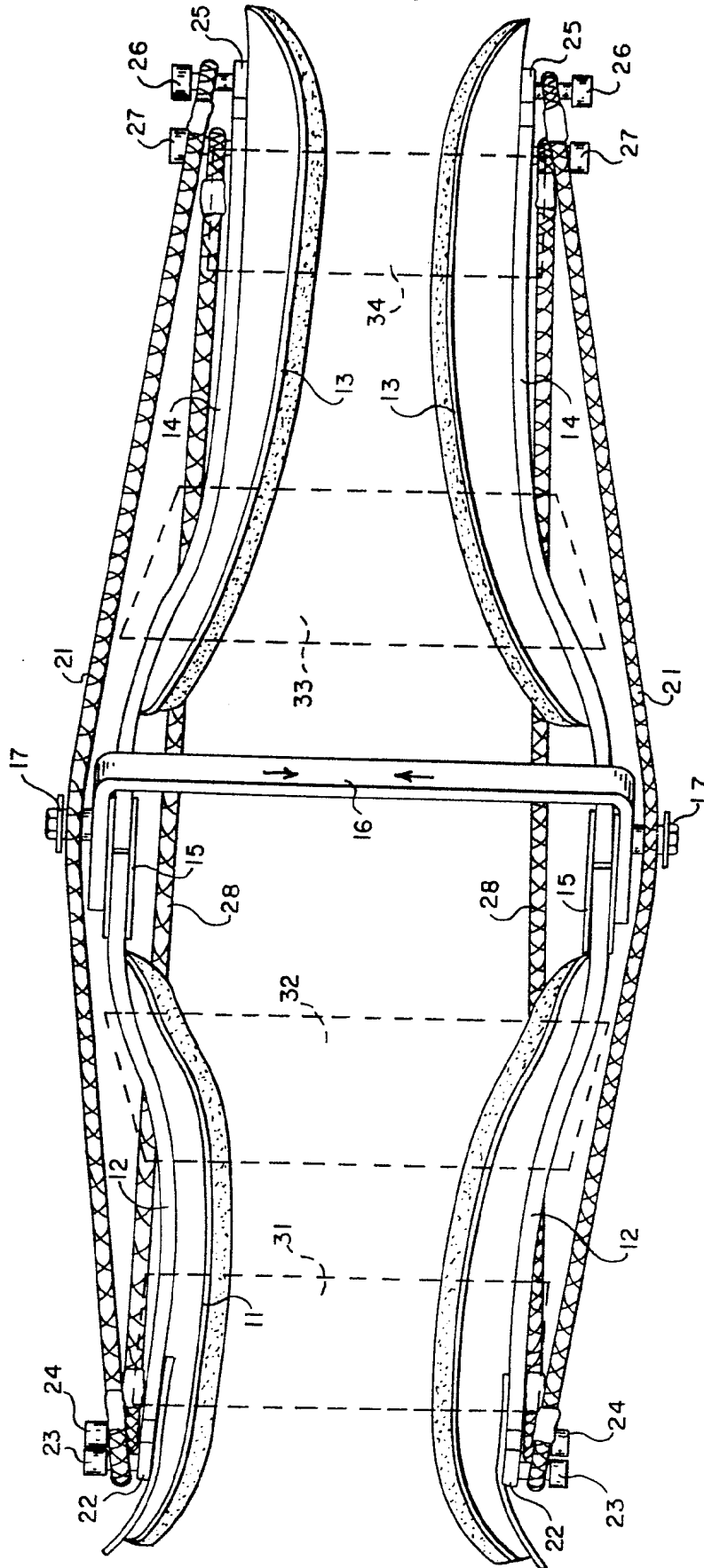


**Fig. 2**



**Fig. 1**





*Fig. 4*